



# WASTEWATER TREATMENT BY A MICROALGAE ISOLATED FROM AN URBAN EFFLUENT


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## INTRODUCTION

Microalgae are an interesting alternative for wastewater treatment due to their capacity to use these wastes as nutritional sources, producing biomass that could be used to obtain several bioproducts by following the circular economy principle (Figure 1).

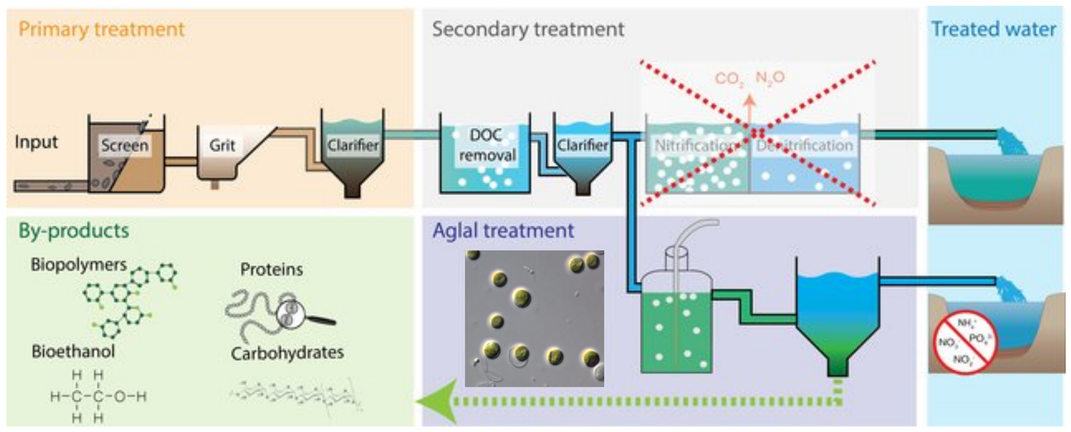



**Figure 1** Microalgae secondary domestic wastewater treatment (Adapted from: Schulze et al., 2016)

This work aims to use a microalgal strain isolated from a partially treated domestic urban effluent as a replacement for the nitrification/denitrification step in the wastewater treatment process.


Schulze et al. Urban wastewater treatment by Tetraselmis sp. CTP4 (Chlorophyta). Bioresource Technology. 2016


## MATERIAL AND METHODS

### MICROORGANISM ISOLATION

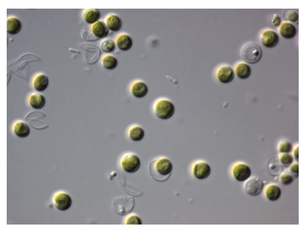


**Figure 2** *Chlorella* sp. GTM 5 isolated using flow cytometry coupled with fluorescence activated cell sorting (FACS)

### CULTURE CONDITIONS

**Parameters**
0.3 g $L^{-1}$ initial concentration
4 L photobioreactors
12:12 h photoperiod, 25ºC
100 $\mu mol_{photons}$ $s^{-1}$ $m^{-2}$

**Urban effluent:** Tertiary wastewater from Quinta do Lago treatment station (Algarve, Portugal)
**Culture adaptation:** batch (5 d)
**Continuous culture** (10 d) HRT: 2d

**Biomass evaluation:** optical density (750 nm)
**pH:** digital pH meter

### BIOMASS RECIRCULATION

Centrifugation 3000 rpm → Supernatant separation → Returning to culture media every 2 d

### WASTE WATER TREATMENT EVALUATION

**Ammonia:** Spectroquant Ammonium test kit (Supelco)

**Total phosphorus:** Colorimetric method (APHA, 1998)

**Biochemical Oxygen Demand (BOD)**: APHA, 1998

**Dissolved Organic Carbon (DOC):** Samples filtration at 0.45µm membranes (TOC-5000A, Schimatzu) (APHA, 1998)

### POPULATION PREDOMINANCE BY FLOW CITOMETRY

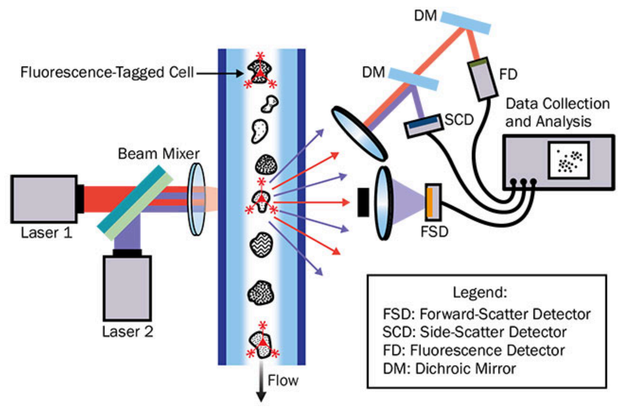



**Figure 3** Flow cytometry scheme Source: Hamamatsu Corp.


Standard methods for examination of water and wastewater, 20 Ed., 1998, APHA, AWWA, WEF


## RESULTS AND DISCUSSION

The following graphs show cell growth results for *Chlorella* sp. GTM 5 with and without biomass recirculation (Figure 4), and ammonia (Figure 5), phosphorus (Figure 6) and DOC (Figure 7) levels for wastewater after and before the treatment with microalgae and the population evaluation.

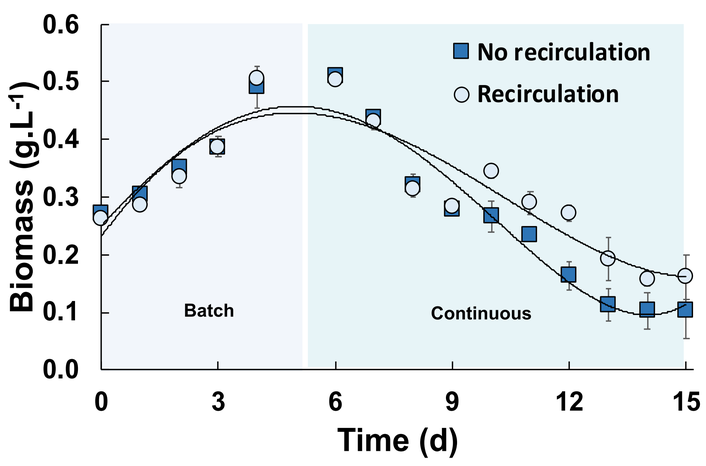



**Figure 4** *Chlorella* sp. GTM 5 growth curve cultured in domestic urban effluent with and without biomass recirculation

The pH in the cultures varied from 8.30 to 9.23 and the BOD for the wastewater was 21 mg $L^{-1}$. *Chlorella* sp. GTM 5 culture was able to reduce BOD to 10,67 mg $L^{-1}$ while in the system with biomass recirculation the BOD decreased to 8.50 mg $L^{-1}$. Both systems were able to remove ammonium and phosphorus to levels below the legislation limits.

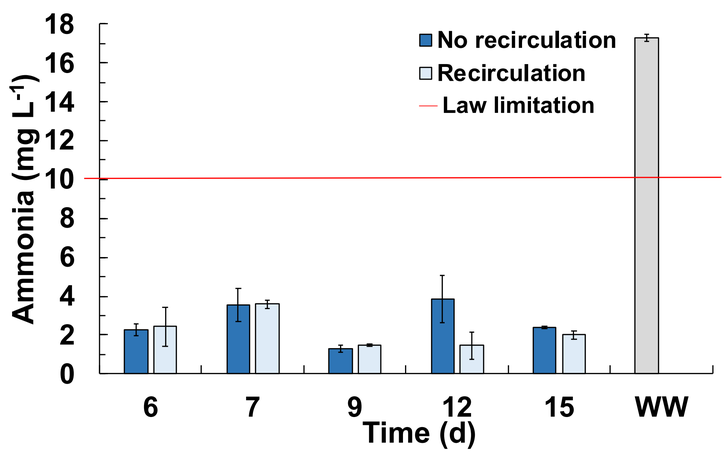



**Figure 5** Ammonia levels in wastewater (WW) treated with *Chlorella* sp. GTM 5 with and without biomass recirculation

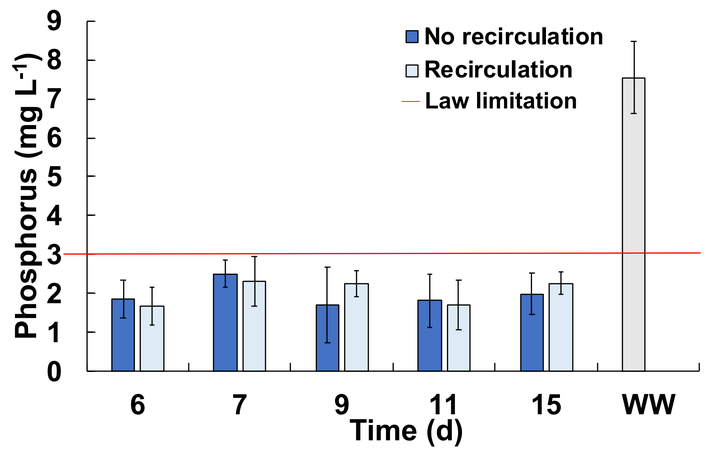



**Figure 6** Phosphorus levels in wastewater (WW) treated with *Chlorella* sp. GTM 5 with and without biomass recirculation

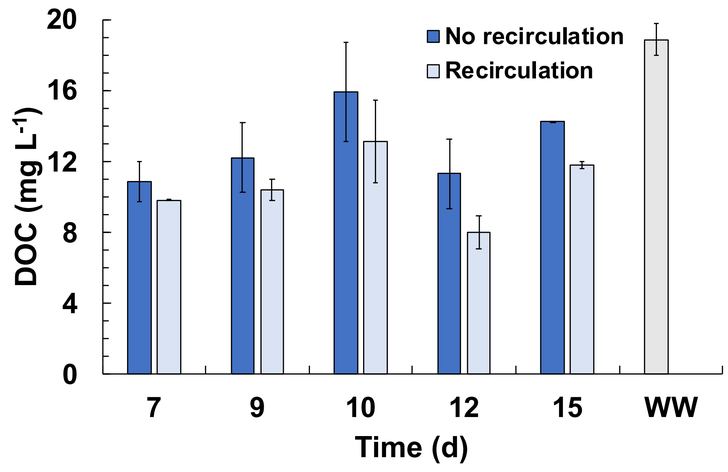



**Figure 7** Dissolved organic carbon (DOC) levels in wastewater (WW) treated with *Chlorella* sp. GTM 5 with and without biomass recirculation (Legislation limit - 150 mg $L^{-1}$)

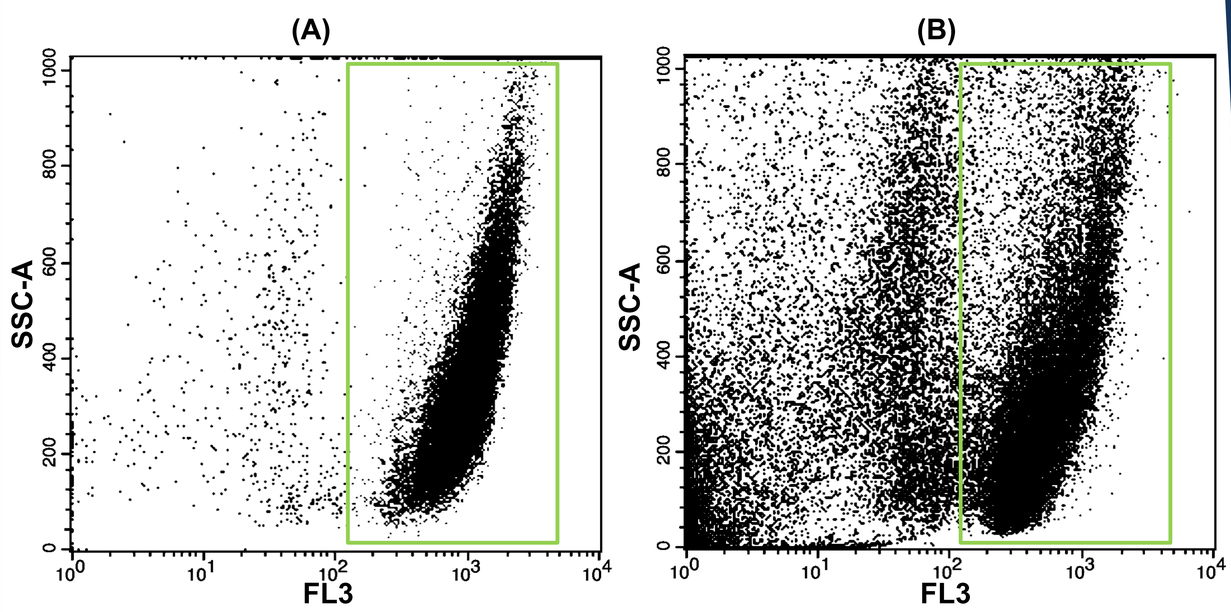


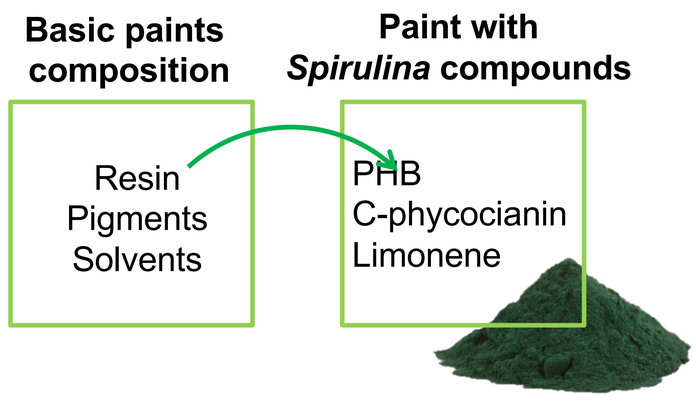

**Figure 8** Flow cytometry dot plots of inner cell complexity (side scatter; SSC-A) versus autofluorescence of chlorophyll (FL3) of *Chlorella* sp. GTM 5 cultivated in wastewater (A) time 7 d and (B) time 15 d.

## CONCLUSION

The microalgae *Chlorella* sp. GTM 5 isolated in wastewater showed the capacity to perform effluent treatment with an average reduction of 85% in ammonia and 70% phosphorus levels framing the treated water values within the limits determined by law for wastewater release in lagoons and reservoirs. The biomass produced in the cultures can be applied to obtain bioproducts, however different hydraulic retention times must be applied in order to improve biomass productivity making the process even more sustainable following the circular economy principle.


## ACKNOWLEGMENTS


Centre of Marine Science – University of Algarve – Faro, Portugal


Basic paints composition
Paint with *Spirulina* compounds
Resin
Pigments
Solvents
PHB
C-phycocianin
Limonene